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GB 673998
GB 613557
GB 397630
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(54) **Apparatus for refuelling aircraft**

(57) Apparatus for refuelling aircraft is installed in a pit BC in the ground and comprises a platform 15 carrying a hose reel 42, filters 41 and instrument panel 40. The platform 15 is raised and lowered by a hydraulic jack 21 and guided by two spaced pairs of vertical hollow guide members 25, 25' of which the guide members 25 are rigid with the platform 15 and the guide members 25' are anchored to the bottom of the pit BC. Each guide member has a bearing cluster 36A-36C at one end which extends through a slot 32' or 32 of the other guide member 25' or 25, respectively to engage the internal walls thereof. A horizontally slidable cover 18 over the platform 15 closes the mouth of the pit when the platform 15 is in its lowermost position. Fuel is supplied to the delivery apparatus on the movable platform 15 from a pipe-line 12 through a flexible hose 60 or telescopic pipe assembly.

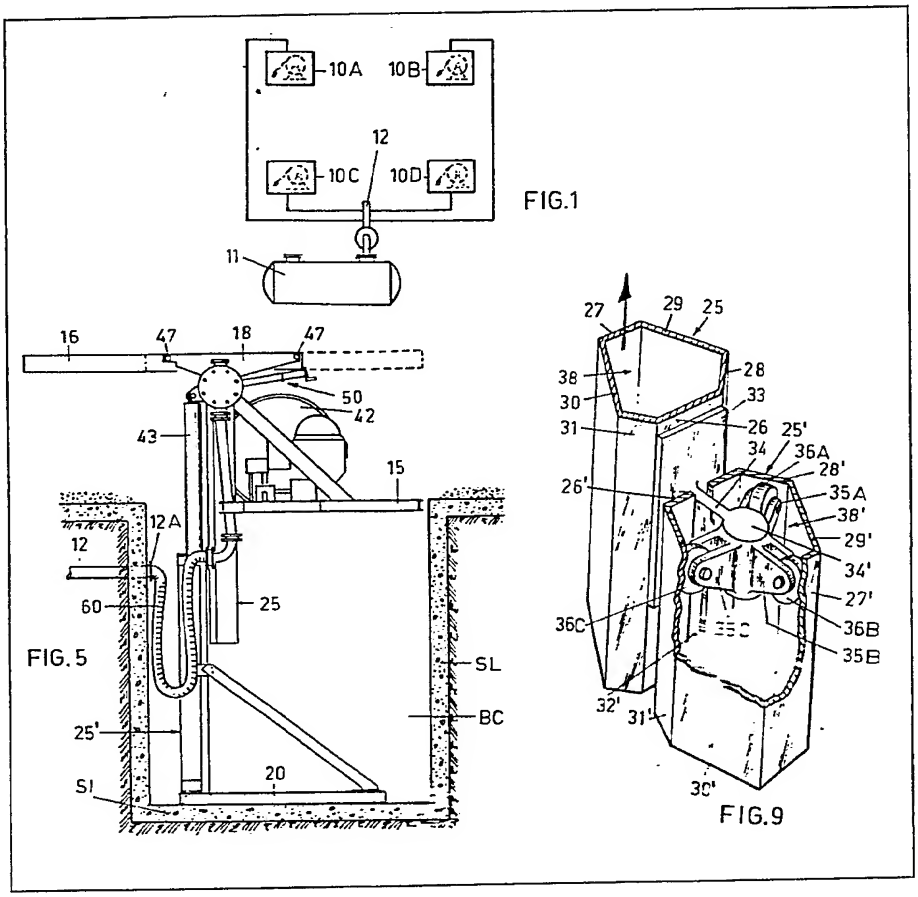

FIG.1

FIG.5

FIG.9

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FIG 10

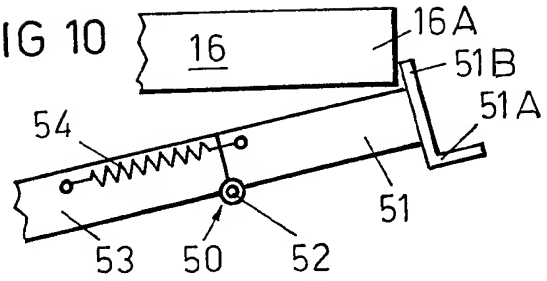
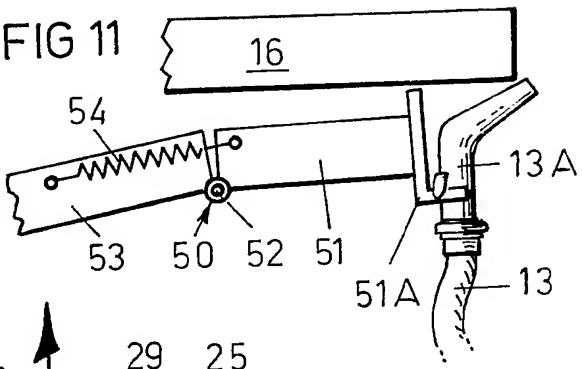


FIG 11



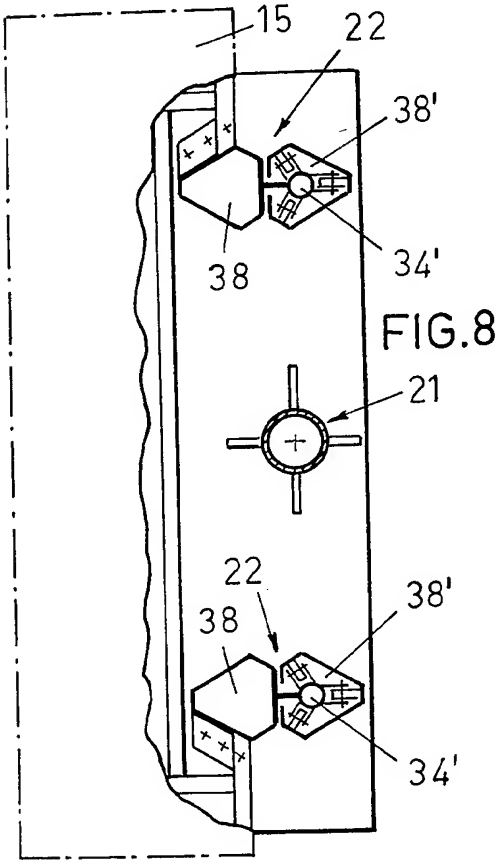


FIG.8

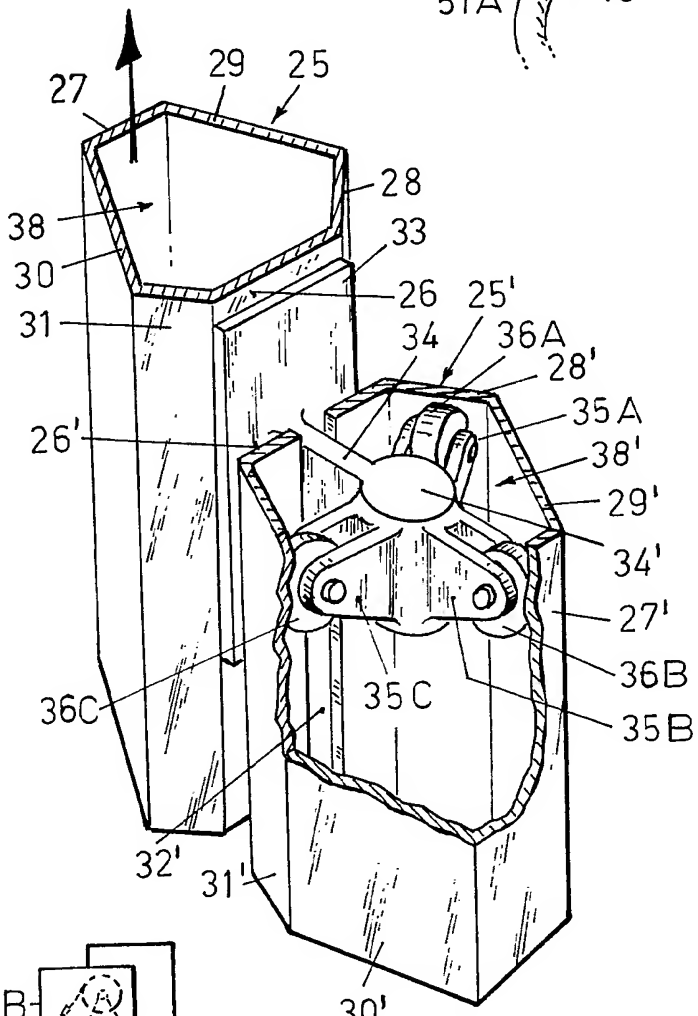


FIG.9

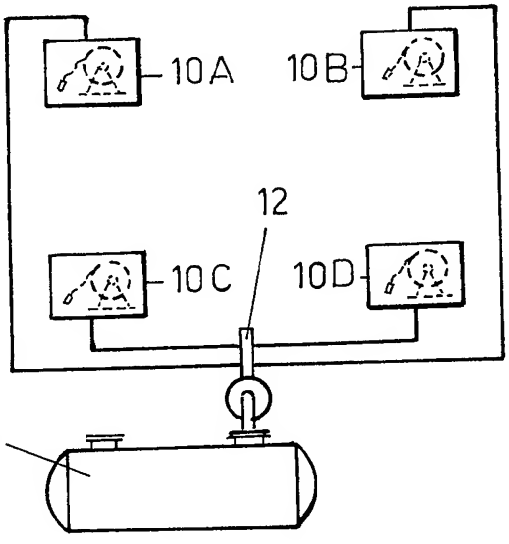


FIG.1

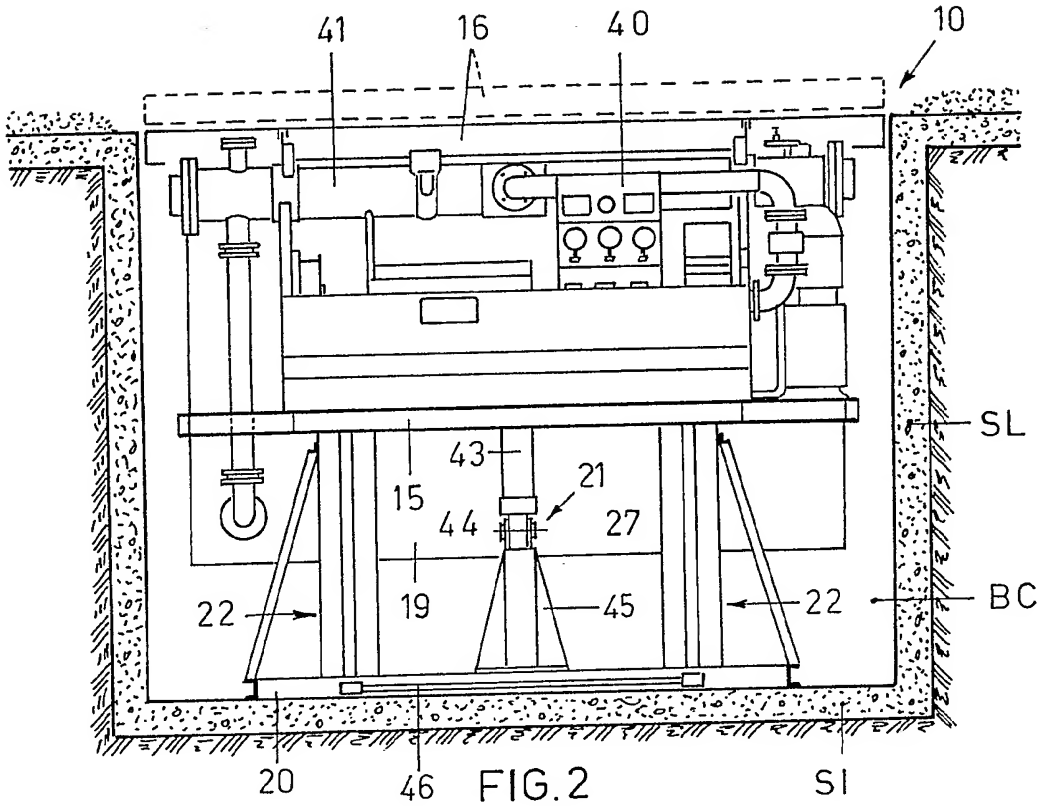

41
16
40
10
SL
43
21
15
44
27
22
19
45
22
BC
20
46
SI

FIG.2

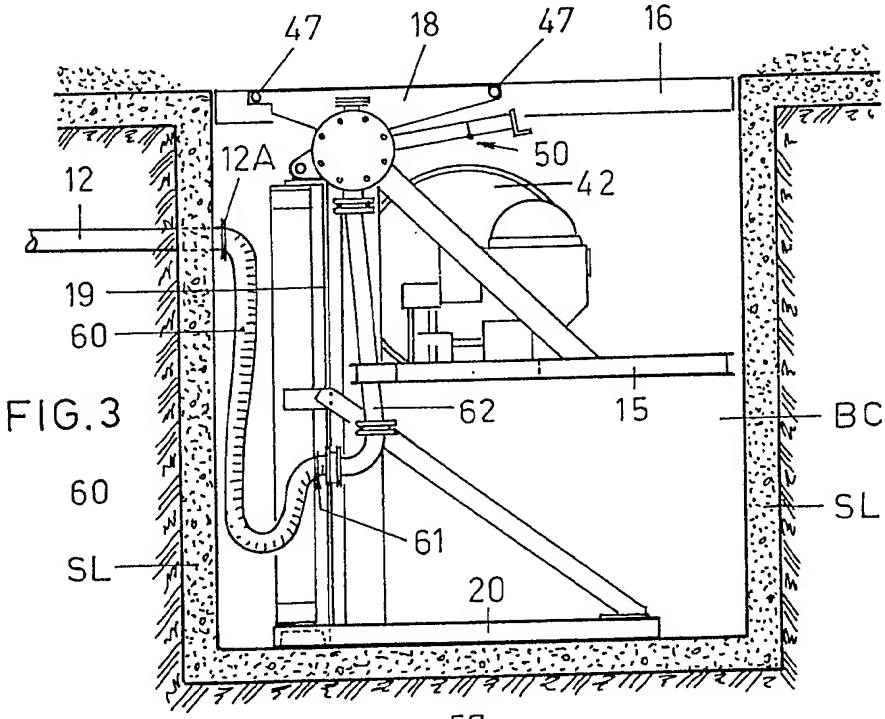

47
18
47
16
12A
50
42
12
19
60
62
15
BC
SL
61
60
SL
20

FIG.3

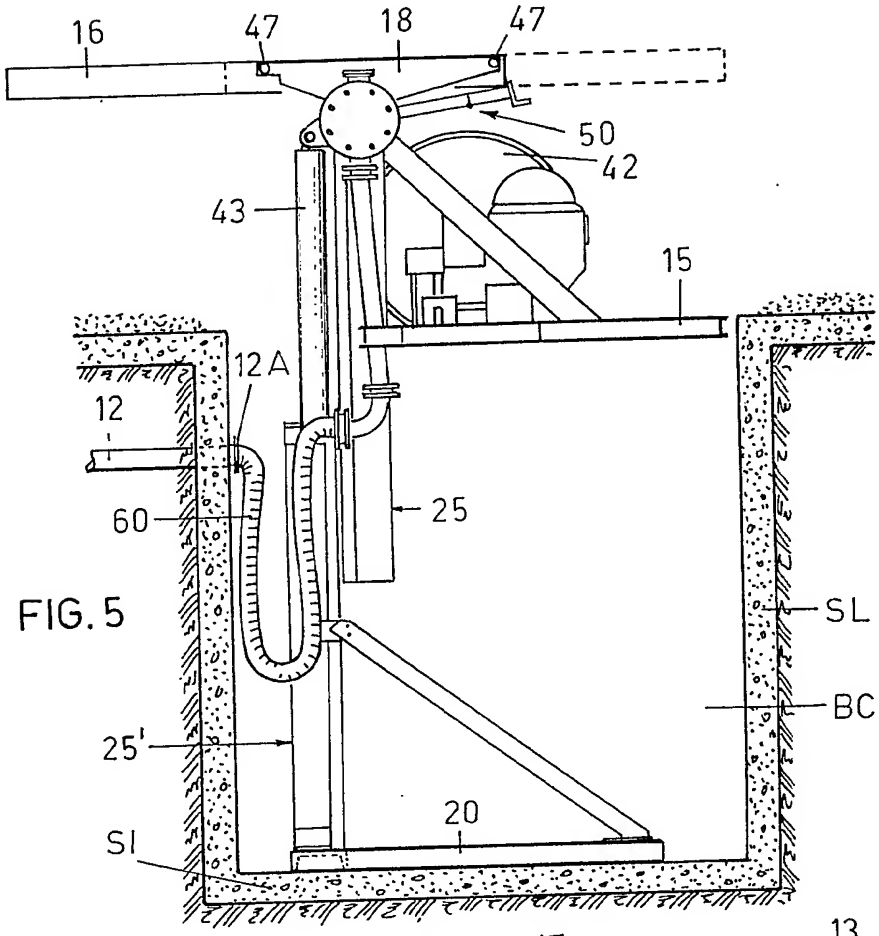

16
47
18
47
50
42
43
15
12A
12
60
25
SL
BC
25'
20
SI

FIG. 5

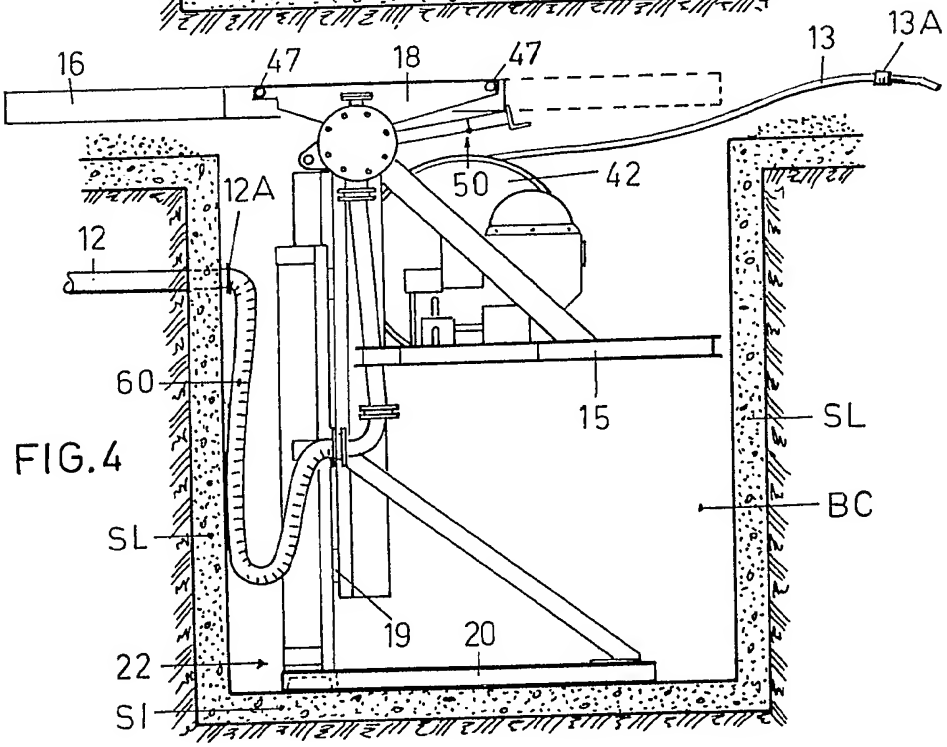

16
47
18
47
13
13A
50
42
12A
12
60
15
SL
BC
SL
19
20
22
SI

FIG. 4

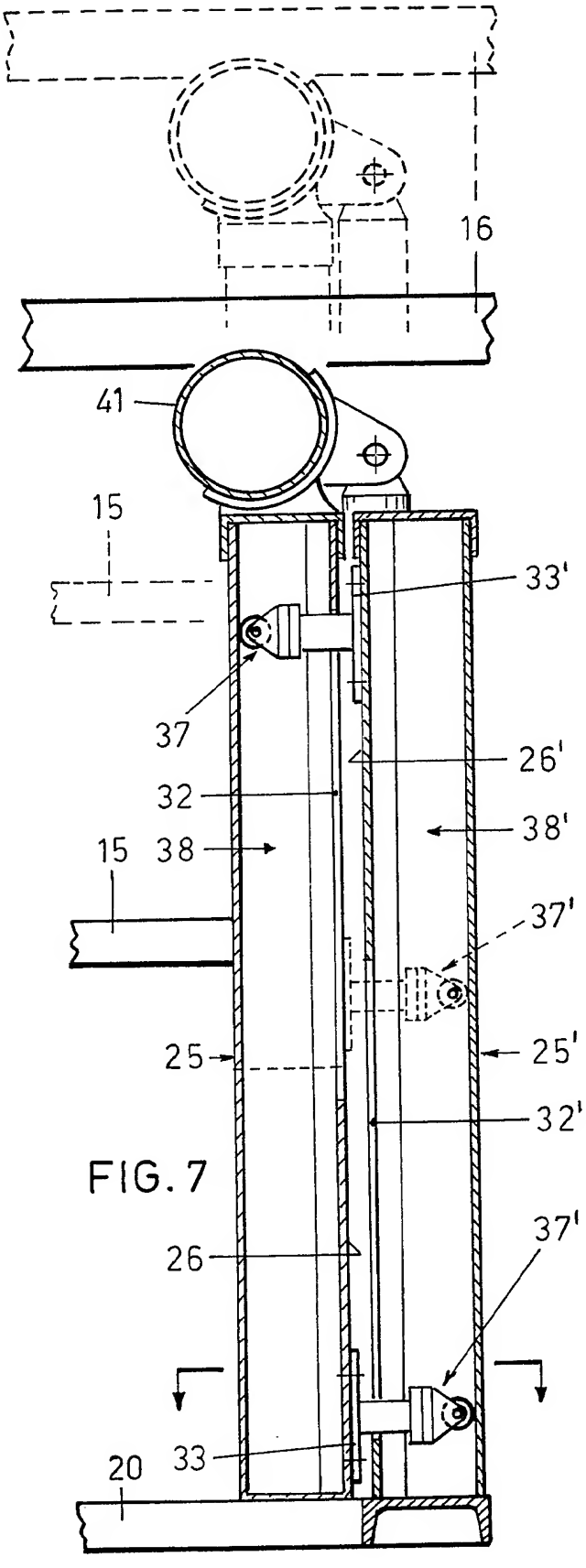

16
41
15
33'
37
26'
32
38'
15
38
37'
25
25'
32'
26
37'
33
20

FIG. 7

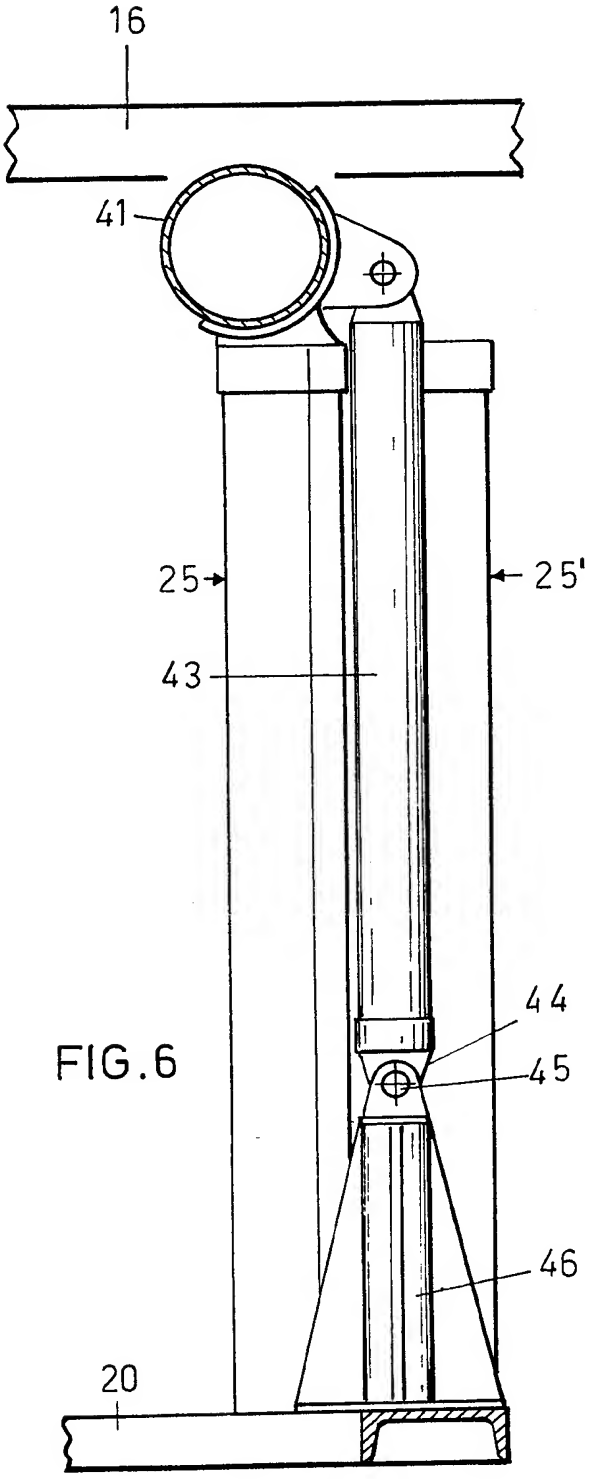

16
41
25
25'
43
44
45
46
20

FIG. 6

SPECIFICATION

Apparatus for refuelling aircraft

This invention refers to a unit adapted to be completely hidden in the ground, comprising all the necessary equipment for delivering fuel to aircraft.

The widespread use of aircraft has brought about the necessity in airports of refuelling simultaneously several aircraft. Heretofore two different systems have been used to perform these refuelling operations.

A first system involves the use of tank-trucks carrying both the fuel to be delivered and all that is necessary for controlling and metering this delivery, such as the delivery pump, hose for connecting the tank truck to the aircraft, filters, manometers, indicators of the rate of flow, meters of the fluid delivered, and the like. These tank-trucks have many inherent drawbacks, such as extremely high cost of purchase, inspection and maintenance and the necessity to be refuelled in turn with the fuel to be delivered to aircraft, which results in dead time for the idle trips with an empty tank from the aircraft parking areas to the main refuelling tank for tank-trucks and back to the parking areas with the tank filled up.

Moreover, tank-trucks are subjected to definite restrictions of bulk and weight and, accordingly, of load, while at present there is a tendency to construct larger and longer aircraft with a resulting increase in the amount of fuel required for the refuelling operations. This makes these vehicles inadequate.

The other system, which is widespread at present, consists in providing airports with a fuel distribution pipe-line from a large central supply tank to a plurality of delivery terminals, each terminal being placed close to an associated aircraft parking area and comprising a delivery opening contained within a closed trap.

However, this system also requires the use of vehicles carrying a hose adapted to connect the delivery opening to the aircraft tank, and also carrying filters, apparatus, instruments and accessories for controlling and metering the delivery operation.

Accordingly, as will be easily understood, this second system too does not overcome the drawbacks resulting from the necessity for a plurality of vehicles to be driven close to the aircraft parking areas to perform the refuelling operation.

This invention provides for a unit which eliminates the necessity of using any vehicles at all for the refuelling operation of aircrafts.

The present invention consists in an aircraft refuelling unit adapted to be completely hidden in a cavity or pit in the ground having the shape of a rectangular parallelepiped, the fuel coming from a tank placed at a distance from said aircraft through an underground delivery pipe-line, said unit substantially comprising: a movable rectangular platform carrying apparatus, including a flexible fuel delivery hose, required to refuel an aircraft; a frame anchored to said platform; a rectangular cover sliding horizontally from a closed position to an open position, said cover being mounted on said frame above said platform and having the same size as the opening of said pit; means received within said pit, for supporting and lifting said platform means completely received within said pit for guiding vertical movement of the platform, and connecting means for connecting the end in said pit of said underground pipe-line to said connecting tube carried by said movable platform, said components of said unit being so arranged that said platform can move from an inoperative lowered position, wherein said cover in the closed position is flush with the edges of said pit thus closing completely and hiding said unit placed therebelow, to a raised delivery position.

In a preferred form of the invention, each terminal of the fuel distribution pipe-line placed close to an aircraft parking area comprises a self-sufficient unit including all the apparatus, devices, instruments and accessories required to refuel an aircraft.

Furthermore, these units or refuelling stations, are completely out of sight when they are not operating.

The construction of the unit is preferably such that the platform can be lifted to a completely raised position in which the platform is substantially at the same level as said edges of said pit thus leaving the unit completely exposed, once said cover has been moved to the open position, said platform being able to stop in at least one partially raised position in which said cover can be moved horizontally to the open position wherein the refuelling operation can be performed through the opening thus obtained without lifting said platform to the completely raised position.

In an emergency, the fuel can then be delivered by slightly raising the unit, since a partial sliding movement of the sliding "roof" or cover is sufficient to expose the unit and thus get out the delivery hose.

The invention will now be described in detail with reference to the annexed drawings, wherein:

Figure 1 is a schematic view of an arrangement of refuelling stations or units according to the invention, in an airport;

Figure 2 is a front elevation with the ground sectioned, showing the unit according to the invention in its concealed or hidden inoperative position;

Figure 3 is a side elevation of the unit shown in Figure 1;

Figure 4 is a similar side elevation showing the unit in a partially raised position;

Figure 5 is a similar side elevation showing the unit in its completely raised position;

Figure 6 is an enlarged fragmentary elevation showing a detail of the raising and guiding members of the unit according to the invention;

Figure 7 is a vertical section of the detail shown in Figure 6, showing the construction of the guiding members;

Figure 8 is a fragmentary top view showing, in smaller scale, the position of the raising and guiding members with respect to the unit;

Figure 9 is an enlarged, partially sectioned perspective view showing in detail the guiding members of the unit;

Figure 10 is an enlarged side elevation showing

the detail of a safety device in its operative position and

Figure 11 is a similar view of the safety device in its inoperative position.

It can be seen that the basic elements of these stations, which are adapted to be completely hidden in the ground and are intended for refuelling aircraft are, as shown in Figure 1, a tank (or a plurality of tanks) 11 adapted to contain the fuel to be delivered to the aircraft, an underground supply pipe-line 12 and a plurality of refuelling units or stations 10A, 10B, 10C, 10D which are adapted to be completely hidden in the ground and are arranged on a landing area, each of them serving one aircraft parking area.

The refuelling units 10A, 10B, 10C, and 10D can move from an inoperative position, wherein they are completely hidden in the ground and then out of sight, to an exposed operative position, by vertically lifting the unit as a whole and causing the roof or cover thereof to slide horizontally.

As clearly shown in Figures 2 and 3, the refuelling station, generally indicated by reference 10, is received within a pit BC, having the shape of an upwardly open, rectangular parallelepiped, dug in the ground of an airport and suitably lined, preferably with a thin side and bottom covering of concrete, as indicated by references SL and SI.

This refuelling station comprises a strong platform 15 having a strong upper cover or roof 16, slidingly mounted on frame 18 carried by platform 15; a rear wall 19; a base 20 anchored to the lower slab SI; a central hydraulic cylinder and piston unit 21 for supporting and lifting platform 15; and two side guiding members 22 substantially aligned with lifting unit 21 and laterally offset with respect to the centre of platform 15, these members 22 guiding the vertical movements of platform 15.

Of course, delivery hose 13 and the related winding drum 42, as well as the accessories required for the fuel delivery operation, will also be mounted on platform 15.

The two guiding members are especially designed to ensure reliable and safe operation wherever the unit according to the invention is installed, both at high latitudes in frozen ground, at extremely low temperatures, and at low latitudes in dry and sandy ground, at high temperatures.

Each guiding member 22 comprises a pair of elongated hollow members (Figures 6 - 9) of which member 25 is anchored to lower slab SI of pit BC and member 25' is rigidly connected to platform 15.

Members 25 and 25' are identical with each other and they are made from strong metal sheet, cut, bent and welded in the form of a right prism having an irregular hexagonal cross section. Each members 25 and 25' comprises a main wall 26 and a wall 27 parallel and opposite thereto. Wall 26 and 27 are connected by two pairs of opposite side walls, 28 and 29, 30 and 31, respectively, and the same numerals are used to indicate the parts of the structure of both members 25 and 25', the numerals referring to member 25' being provided with an apostrophe.

Moreover, main wall 26 is provided with a central longitudinal slot 32 extending throughout the length thereof with the exception of a short end length where a plate 33 is welded to main wall 26.

A sturdy web 34 integral with plate 33 carried at the free end thereof a length of a cylindrical support 35 comprising three forks 35A, 35B, 35C protruding therefrom. These forks are uniformly spaced 120° from each other and each of them carries a ball bearing freely rotatably mounted therein. The ball bearings are indicated by references 36A, 36B and 36C, respectively, and the unit comprising these bearings and the support thereof is generally indicated by reference 37 (or 37').

As clearly seen in Figures 7 and 9, hollow members 25 and 25' having identical structures and forming together each guiding member, are placed side by side and one is upside-down in respect to the other so that main wall 26 and 26' are parallel and adjacent to each other, grooves 32 and 32' correspond to each other and web 34 (or 34') of a guiding member 25 (or 25') is received within groove 32' (or 32) of the other guiding member, so that unit 37 of member 25 is received within cavity 38' of member 25' and unit 37' of member 25' is received within cavity 38 of member 25.

It can be noted that forks 35A, 35B, and 35C are so arranged and of such length that, when members 25 and 25' are assembled and each unit 37 or 37' is received within cavity 38 or 38', bearings 36A, 36B and 36C of the member 25 form rollers and are respectively engaged with walls 28', 27' and 30' of the member 25' and the bearings of the member 25' are respectively engaged with walls 28, 27 and 30 of the member 25, so that members 25 and 25' can freely move vertically in respect to each other, while units 37 and 37' ensure steady sliding connection therebetween and easily withstand torque which could cause platform 15 to incline with respect to the horizontal.

It should be noted here that the structure and position of members 25 and 25', which are vertical and open at the bottom thereof, and the nature of bearings 36 and 36' (A, B, C), which are closed and self-lubricated, ensure the operation of the guiding members even in particularly difficult environmental conditions, such as in the case of installation in desert areas where the sand, by its very nature, accumulates in and penetrates into the relatively movable members, thus hindering the movement thereof.

As described above the apparatus and accessories necessary to perform the refuelling operation of an aircraft, such as manometers, meters of the rate of flow, opening and closing gate valves, operation controls, all schematically represented on control board 40, filters 41 and delivery hose 13, that is wound on drum 42, are all mounted on platform 15 and protected by moveable cover 16.

The roof or cover 16 comprises a thick rectangular steel plate having the same size as the opening of pit BC and slidably mounted on rollers 47 which can freely rotate on frame 18.

Furthermore, as mentioned above, platform 15 is supported by a hydraulic cylinder and piston unit or jack 21 which comprises a cylinder 43 (Figures 6 and 7) rigid with platform 15 and a piston, the stem of

which is provided with a "foot" 44 pivoted on pin 45 integral with base pillar 46 which is rigid with the bottom slab SI of pit BC. It should be noted that the above-described connection with base pillar 46 allows hydraulic cylinder and piston unit 21 to follow the inevitable small oscillations of platform 15 during its vertical movements.

With such an arrangement, station 10 is completely hidden and out of sight when platform 15 is in the lowered position (Figures 2, 3 and 4).

By suitable operation of hydraulic unit 21, station 10 can be lifted to the raised delivery position (Figure 5), in which cover 16 can move backwards sliding on rollers 47 from the position drawn in phantom lines to the position drawn in full lines, in order to have easy access to hose 13 and the various controls.

The refuelling station of the invention is provided with a safety device 50 preventing cover 16 from closing inadvertently since, due to its weight, this cover could seriously injure the operators of the refuelling station.

This safety device essentially comprises a rest on which a delivery head 13A of hose 13 can be hung comprising a fork element 51 hinged at 52 on a base 53. A tension spring 54 is arranged between fork element 51 and base 53.

With such an arrangement, device 50 will be in its inoperative lowered position, shown in Figure 11, against the action of spring 54 which is now extended, owing to the weight of the delivery head 13A hung on a fork 51A of element 51, while device 50 will move to the position shown in Figure 10 when delivery head 13A is removed from fork 51, once cover 16 has been moved to the open position shown in Figure 5.

It will be noted here that with this construction of fork element 51 and cover 16, edge 16A of cover 16 lies behind an upward projection 51B of fork 51A and, accordingly, the cover 16 cannot reach its completely closed position (towards the right in the Figure) even if inadvertently pushed, thus avoiding any injuried to the operators that are standing on platform 15.

It should also be noted that the unit according to the invention can be used in many ways and it also allows aircraft to be refuelled even without completely lifting platform 15. As a matter of fact, in an emergency, to get access to hose 13 and controls 40 of the station it will be sufficient to lift platform 15 slightly and to slide cover 16 to the open position (Figure 4).

In this situation an operator can go down onto the platform and get out hose 13 therefrom for the refuelling operation without completely lifting the station.

Finally, the movable connection for supplying fuel from end 12A of the underground tube 12 from central tank 11 to hose 13, which is mounted on movable platform 15, can be made with a flexible tube 60 having one end connected to an end 12A of underground tube 12 and the other end connected to a lower end 61, protruding rearward from wall 19, of an upwardly directed tube 62, the other end of which is connected to filters 41 and to drum 42 on which hose 13 is wound.

However, at present the extensible connecting unit disclosed in British Patent Application No. 79 05322, in the name of the same applicant, is preferably used in connection with aircraft refuelling stations.

CLAIMS

1. An aircraft refuelling unit adapted to be completely hidden in a cavity or pit in the ground having the shape of a rectangular parallelepiped, the fuel coming from a tank placed at a distance from said aircraft through an underground delivery pipe-line, said unit substantially comprising: a movable rectangular platform carrying apparatus, including a flexible fuel delivery hose, required to refuel an aircraft; a frame anchored to said platform; a rectangular cover sliding horizontally from a closed position to an open position, said cover being mounted on said frame above said platform and having the same size as the opening of said pit; means received within said pit, for supporting and lifting said platform, means completely received within said pit for guiding vertical movement of the platform, and connecting means for connecting the end in said pit of said underground pipe-line to said connecting tube carried by said movable platform, said components of said unit being so arranged that said platform can move from an inoperative lowered position, wherein said cover in the closed position is flush with the edges of said pit thus closing completely and hiding said unit placed therebelow, to a raised delivery position.

2. A unit according to Claim 1 wherein the platform can be lifted to a completely raised position in which the platform is substantially at the same level as said edges of said pit thus leaving the unit completely exposed, once said cover has been moved to the open position, said platform being able to stop in at least one partially raised position in which said cover can be moved horizontally to the open position wherein the refuelling operation can be performed through the opening thus obtained without lifting said platform to the completely raised position.

3. A unit according to claim 1 or claim 2, wherein said supporting and lifting means comprises a hydraulic cylinder and piston unit.

4. A unit according to any preceding claim, wherein said guiding means comprises at least two hollow guide members arranged vertically and side by side, one hollow guide member being firmly connected to said platform and said other hollow guide member being anchored to the bottom of said pit, each of said hollow guide members having a longitudinal slot and external supporting means disposed at one end of said longitudinal slot and adapted to be received within the cavity of said other hollow guide member through said slot thereof, said means supporting a plurality of idle rollers adapted to engage the internal walls of the cavity of said other hollow guide member and to freely roll on said internal walls during relative axial movement of one of said hollow guide members with respect to the other.

5. A unit according to claim 4 wherein the guide

members are open at the bottom end thereof.

6. A unit according to claim 4 or claim 5, wherein two pairs of the hollow guide members identical with each other are arranged at the sides of said hydraulic unit and aligned therewith, said hollow guide members being each made from a solid metal sheet and shaped as a prism of an irregular hexagonal cross-section having a main wall, bearing a plate at one end and having a central longitudinal slot, extending throughout the remaining length of said main wall, a web integral with said plate, a support element of cylindrical shape mounted at the end of said web and three rollers freely rotatable between the branches of three corresponding forks, each radially spaced at 120° from the others and integral with said cylindrical support, said two hollow guide members being placed side by side and one being upside-down in respect to the other, the respective main walls thereof being adjacent and parallel to each other, the web of one of said hollow guide members being received within the slot of said other hollow guide member, so that said three bearings integral with the respective cylindrical support of each of said hollow guide members are received within the cavity of said other hollow guide member and in roller engagement with three inner walls thereof not adjacent to each other.

7. A unit according to claim 6 wherein the rollers are sealed self-lubricated ball bearings.

8. A unit according to any preceding claim, wherein said connecting means connecting the end in said pit of said underground tube, to said connecting tubes mounted on said movable platform comprises an extensible unit according to British patent application no. 79 05322 in the name of the same applicant.

9. A unit according to any preceding claim, further comprising a safety device adapted to prevent said sliding cover from sliding back to its completely closed position during the refuelling operation.

10. A unit according to claim 9, wherein said safety device comprises spring-biassed rest means for supporting delivery head means at the end of said hose, the supporting means being pivoted so as to swing from an inoperative lowered position, against the action of said spring means, when the delivery head means is supported thereby, to an operative, safety raised position, to which the supporting means is biassed by said spring means, whenever said delivery head means is detached from said rest means in order to perform said refuelling operation, and in which said rest means is in the path of said cover preventing the same from sliding back to its completely closed position.

11. A re-fuelling unit substantially as described herein with reference to, and as illustrated by, the accompanying drawings.

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